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BIFI SHALLOW WATER TESTS.(U)

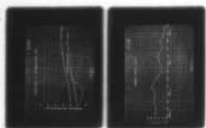
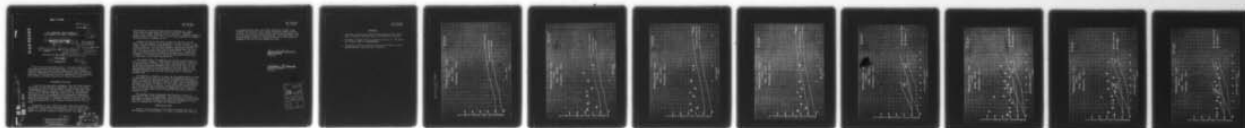
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NAVY UNDERWATER SOUND LABORATORY  
FORT TRUMBULL, NEW LONDON, CONNECTICUT

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6 BIFI SHALLOW WATER TESTS.

SECOND PROGRESS REPORT, No. 2,

9 by

10 Bernard Sussman and William G. Kanabis

USL Project No.  
8-1-401-00-00

17 SF 11 552 001-11282

14 USL-TM-  
USL Technical Memorandum No. 2211-172-68

F11552

11 20 June 1968

12 14p  
INTRODUCTION

This is the second progress report on the shallow water acoustic tests being conducted over the BIFI range. It covers operations conducted during the months of April, May and June 1966. Reference (1) contains a description of similar tests conducted previously over the same range. In what follows, only brief descriptions of the procedures will be given, as further details may be found in reference (1).

## PROPAGATION LOSS TESTS

As was the case previously, propagation loss tests were conducted twice daily at three operating frequencies. However, the two outer frequencies were set at 1500 and 1900Hz in order to bring them closer to the 1700Hz resonance frequency of the projector. The previously used values of 1200 and 2400Hz had turned out to be unsatisfactory. Simultaneously with the propagation loss measurements, observations were made of sea state and wind speed and direction at both Fishers Island and Block Island. In addition, during the month of June, a set of bathythermograms (BT's) was obtained at several points along the range.

Propagation loss was computed for each of the three operating frequencies and the results were plotted as a function of sea state in Figures 1-4. Figure 1 shows the individual values at 1700Hz, while Figures 2-4 show the respective averaged values. Also shown for

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reference are the predicted limits based on reference (2). These curves show the lowest predicted loss for the case of isothermal water, and the highest predicted loss for water with a negative temperature gradient down to the bottom. Thus, the two curves represent the maximum predicted spread in propagation loss.

Figures 5-8 show the same data as above as a function of wind speed. For these graphs, it was necessary to convert sea state to wind speed in order to plot the predicted values. Two sets of data were used in this conversion. For the curves marked A, simultaneous readings of wind speed and sea state taken at Block Island during these tests were used. The curves marked B are based on reference (3). In each case, the lower and upper curve correspond to the same thermal conditions as in Figures 1-4. Further details concerning conversion from sea state to wind speed will be found in reference (1).

The extreme values of propagation loss measured in this series of tests are shown in Figure 9. Data covering all six months of operations to date were used in plotting this figure. The dashed curve near the bottom shows the minimum propagation loss measured for each sea state. The horizontal dashed line, corresponding to the 135Db value, is the maximum propagation loss which the system can measure. Since, in some instances no signals were received, the actual loss in these cases exceeded 135Db.

An examination of Figures 2-4 shows that the average values obtained in these tests do not agree very well with the COLOSSUS predictions. In almost all instances, the measured values are higher than the predicted values, with many discrepancies in excess of 10Db. Similar discrepancies also exist, of course, in Figures 6-8. The authors have no explanations for these discrepancies at present. During the period covered by these tests, the typical temperature gradient changed from zero to negative. This fact was taken into account in calculating the predicted limits of propagation loss.

The agreement between measurement and prediction is better in reference (1) than in this memorandum. This would seem to indicate that when negative velocity gradients exist in Long Island Sound, factors other than those considered in reference (2) affect the propagation in such a way as to increase the loss beyond the predicted value.

#### AMBIENT NOISE TESTS

Figure 10 shows the ambient noise levels as measured just prior to each propagation loss measurement. It should be stressed that these are

not average ambient levels, but rather the levels to which it was necessary for the noise to fall before propagation signals could be received. The trend is clearly towards lower values of ambient noise as one progresses towards the warmer months. This trend toward lower required ambient levels is a qualitative measure of the increase in propagation loss as the water temperature rises.

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REFERENCES

1. "BIFI Shallow Water Tests, First Progress Report" by B. Sussman and W. G. Kanabis, USL Tech Memo No. 2211-30-66 dtd 3 Nov 66.
2. "COLOSSUS II Summary Report" by Raymond W. Hasse, Jr., USL Report No. 513 dtd 3 July 61. (CONFIDENTIAL)
3. "Generation and Classification of Sea State" by David P. Wilson, USL Tech Memo No. 963.2-8-62 dtd 13 July 62.

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2241-172-58

# PROPAGATION LOSS

VERSUS

SEA STATE

FREQUENCY 1700

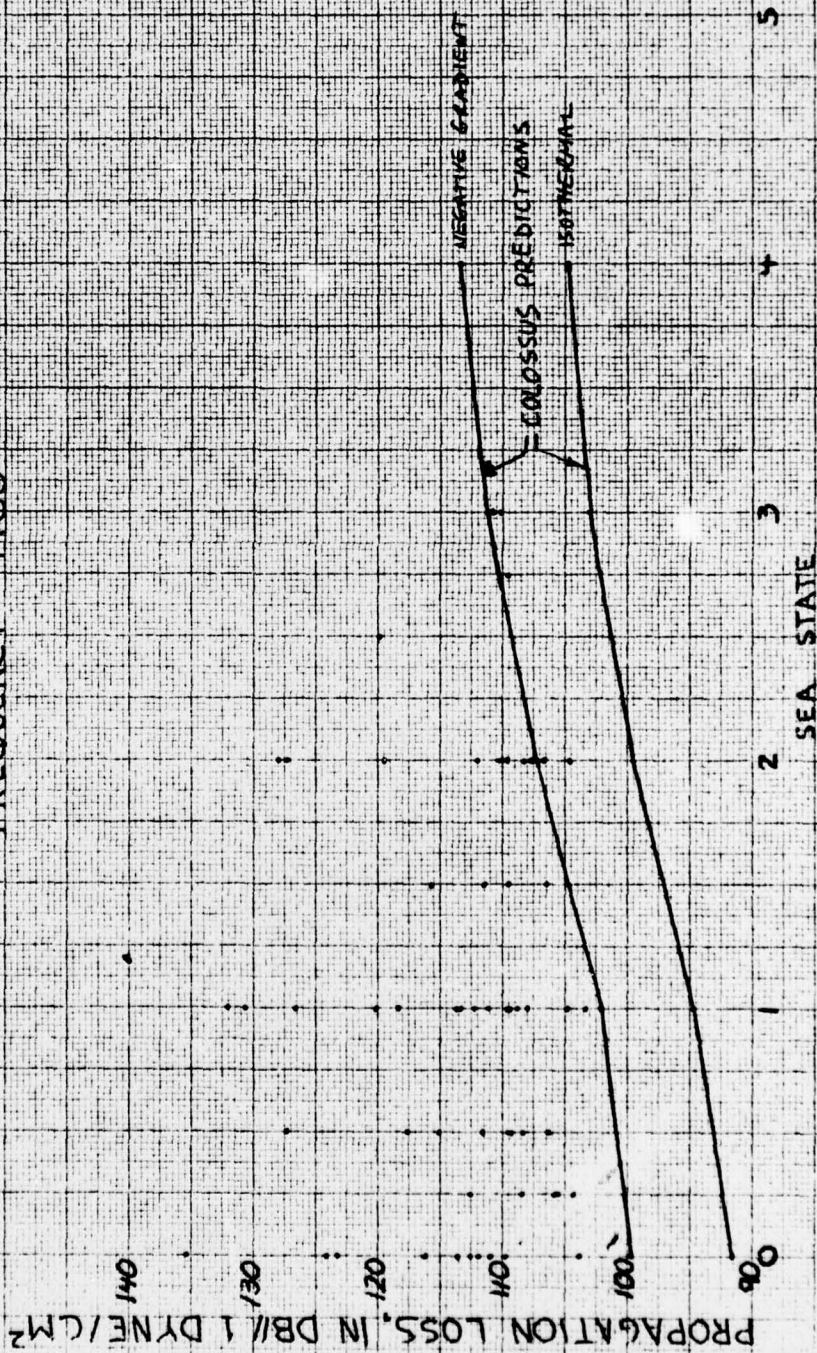


FIGURE 4



# PROPAGATION LOSS VERSUS

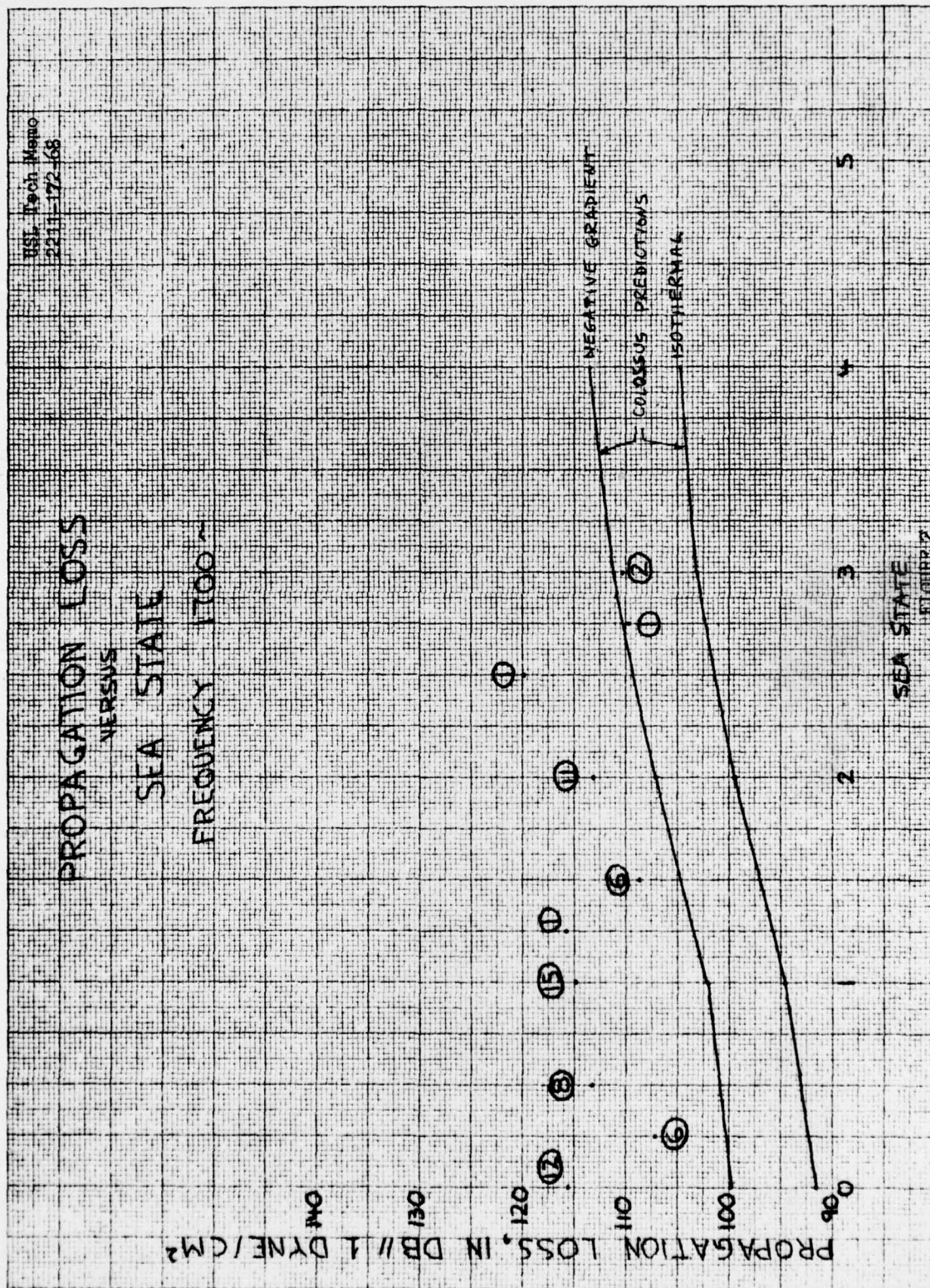
SEA STATE

FREQUENCY 1700 ~

PROPAGATION LOSS, IN DB// 1 DYNE/CM<sup>2</sup>

NEGATIVE GRADIENT  
COLLOSSUS PREDICTIONS  
ISOTHERMAL

SEA STATE  
FIGURE 2



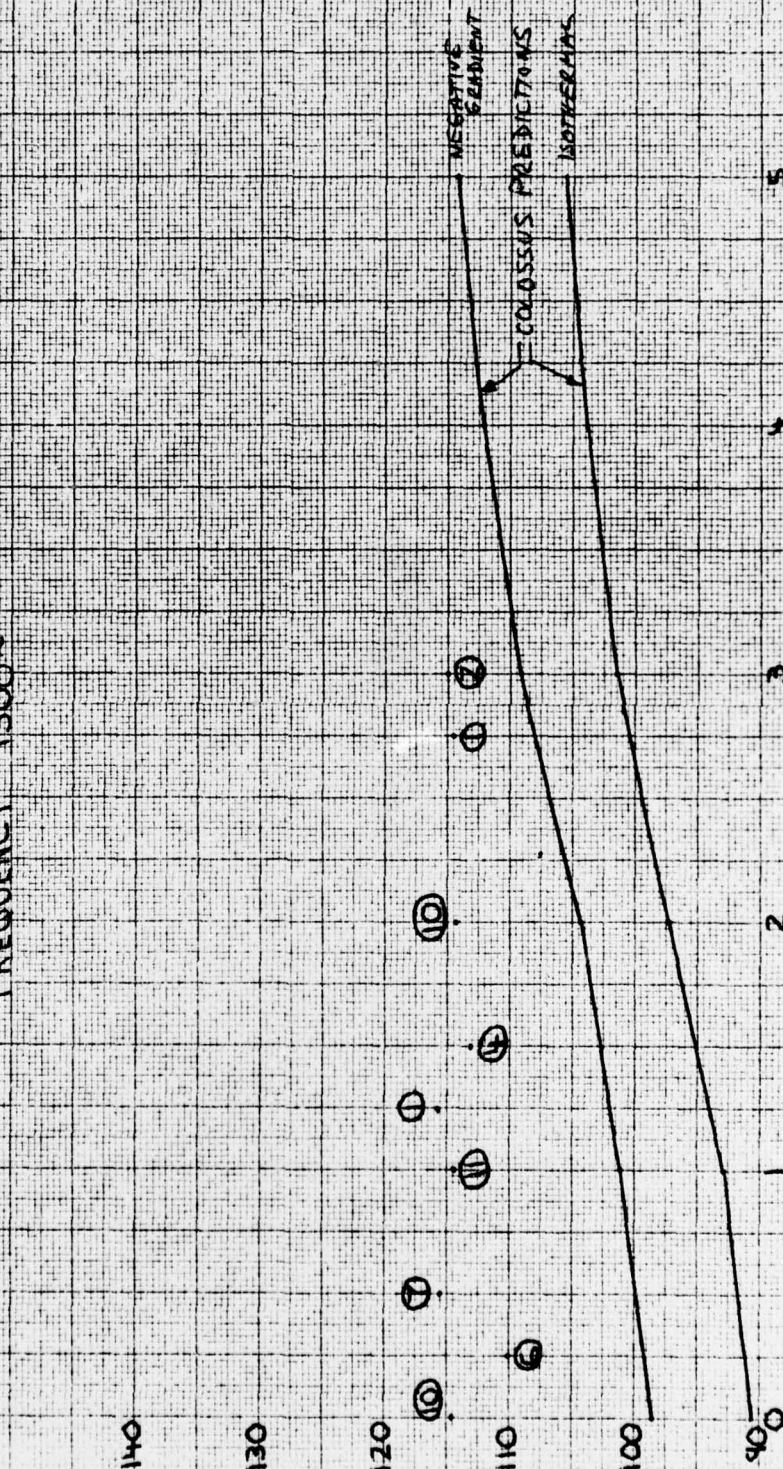
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# PROPAGATION LOSS VERSUS

SEA STATE

FREQUENCY 1500~

PROPAGATION LOSS IN DB/1 DYNE/CM<sup>2</sup>



SEA STATE  
FIGURE 3



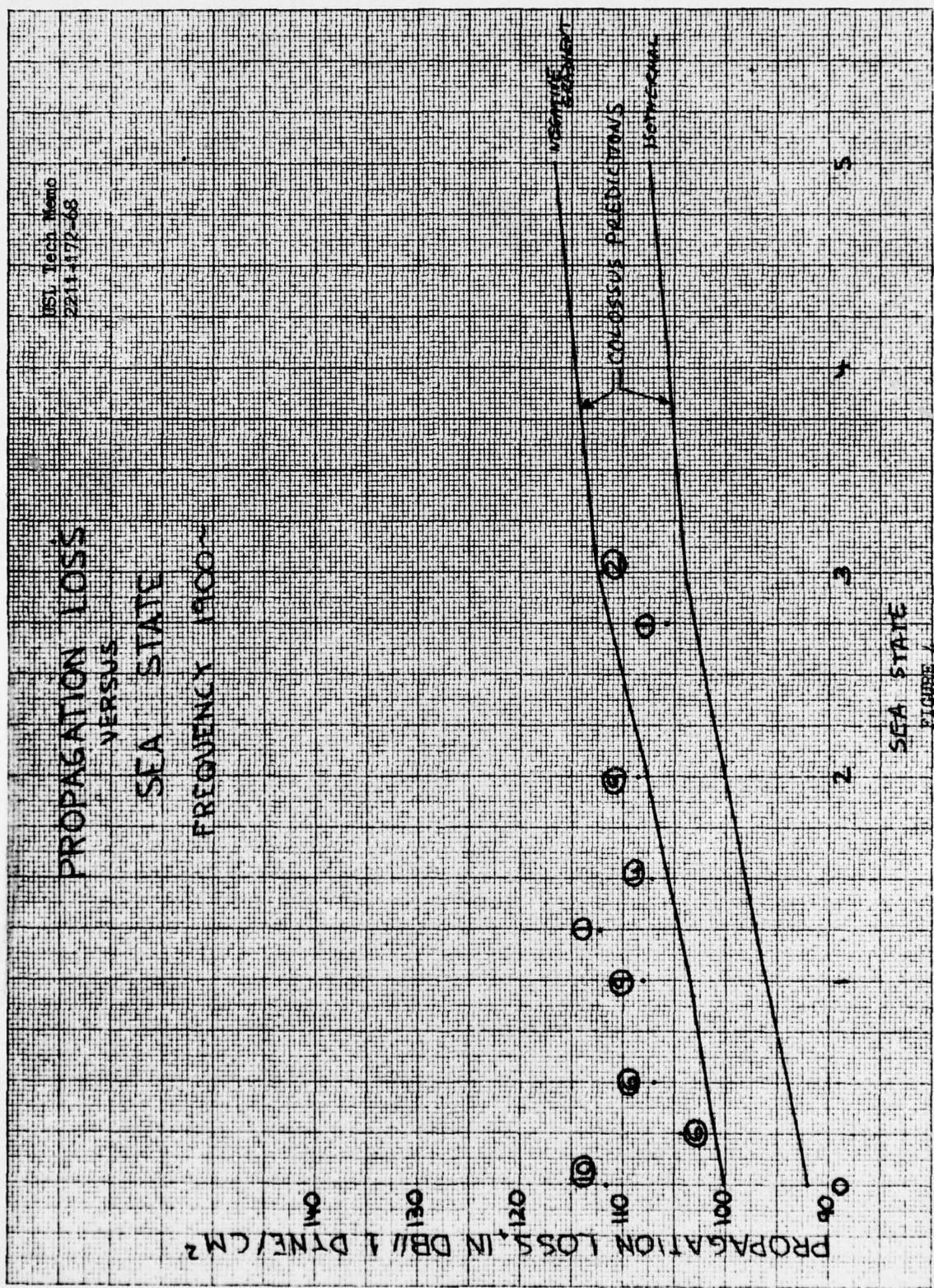
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# PROPAGATION LOSS VERSUS SEA STATE FREQUENCY 1900~

PROPAGATION LOSS, IN DB/1 DYNE/CM<sup>2</sup>

WATER SURFACE  
COLLOSSUS PREDICTIONS  
HOMOCENTRAL

SEA STATE  
FIGURE 4



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# PROPAGATION LOSS VERSUS

WIND SPEED

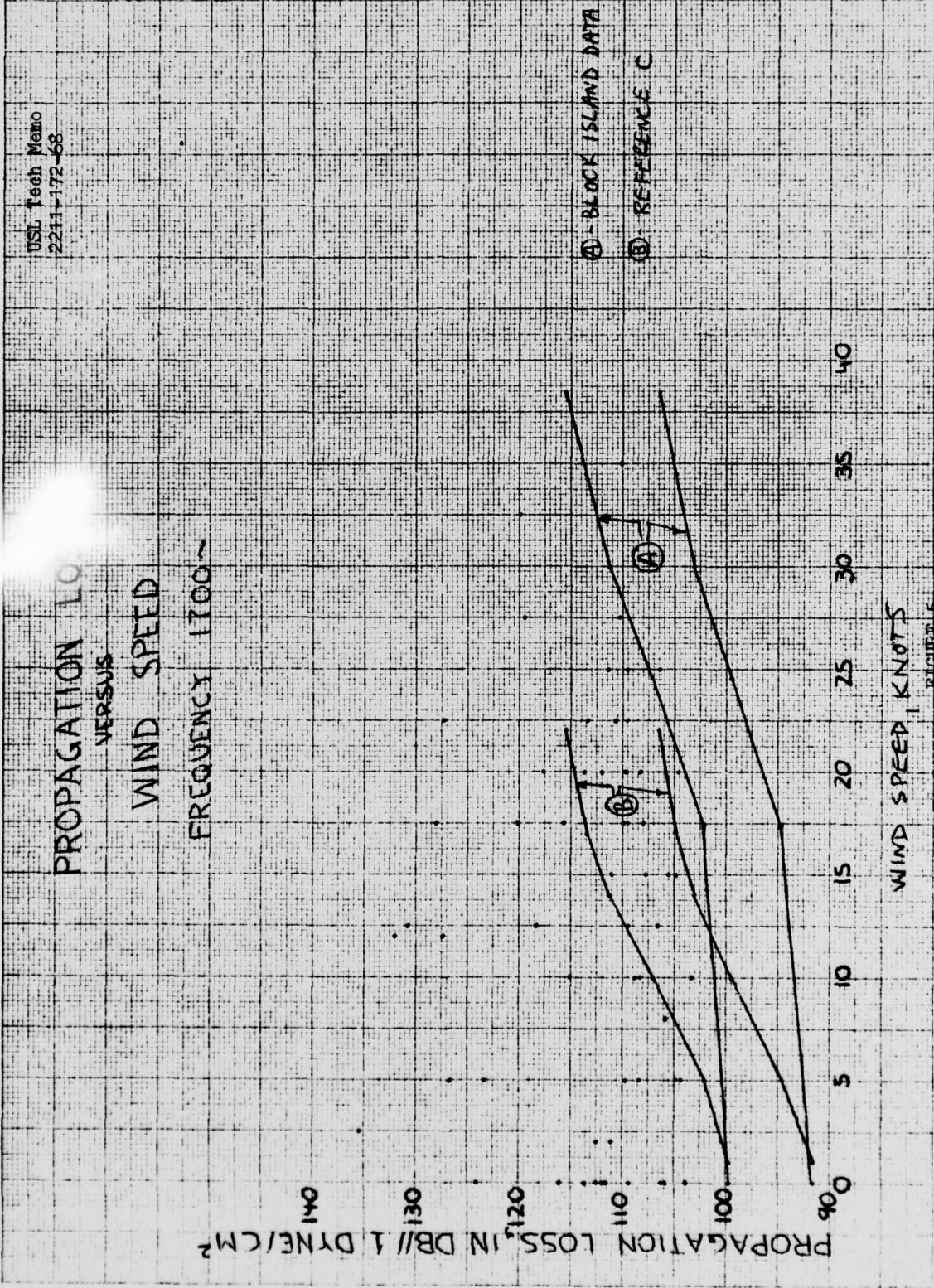
FREQUENCY 1700~

PROPAGATION LOSS, IN DB// 1 DYNE/CM<sup>2</sup>

WIND SPEED, KNOTS

(A) - BLOCK ISLAND DATA  
(B) - REFERENCE C

FIGURE 5





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# PROPAGATION LOSS VERSUS WIND SPEED FREQUENCY 1700~

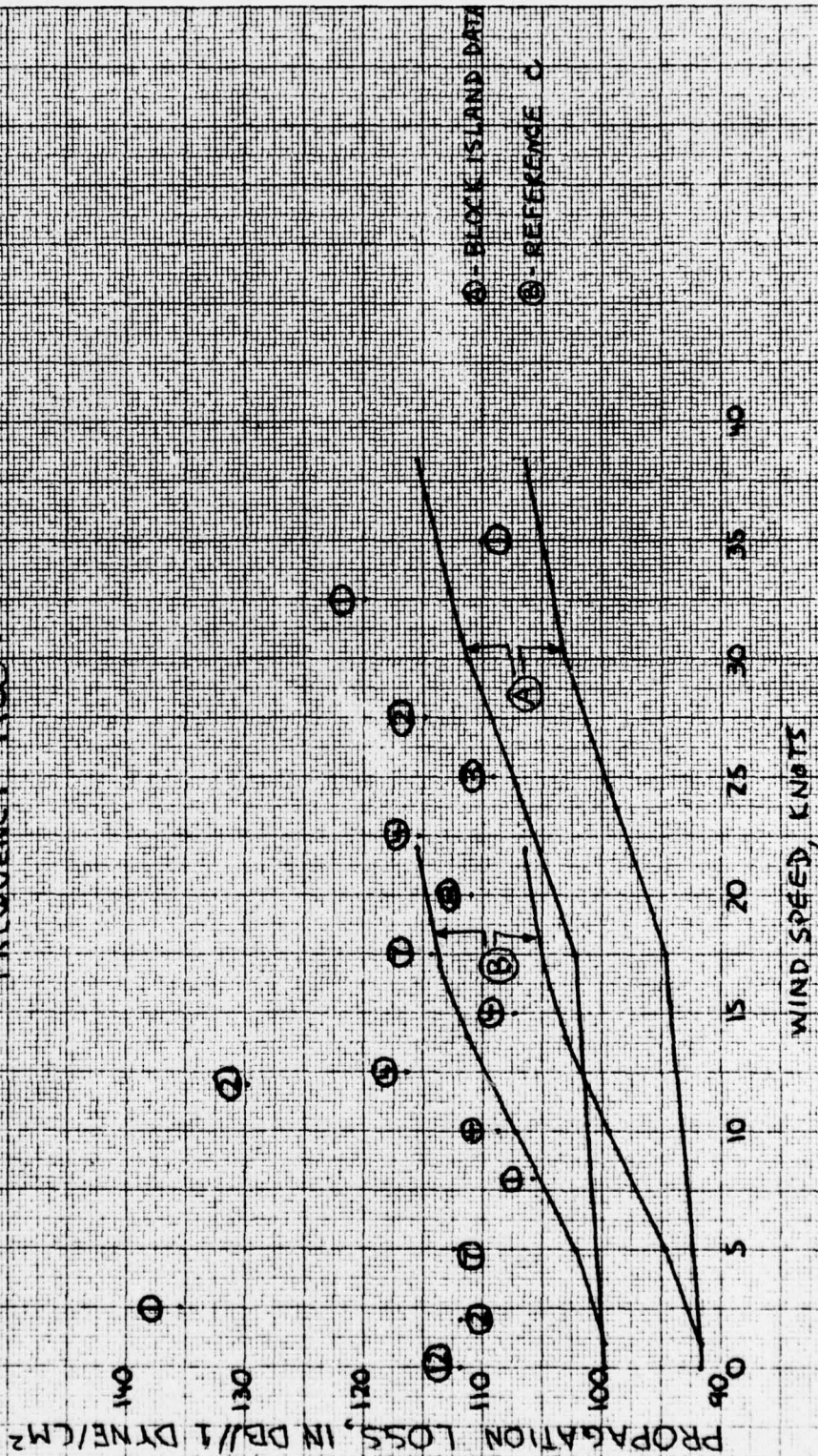


FIGURE 6

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# PROPAGATION LOSS VERSUS WIND SPEED FREQUENCY 1500 ~

PROPAGATION LOSS, IN DB// 1 DYNE/CM<sup>2</sup>

WIND SPEED, KNOTS

① BLOCK ISLAND DATA  
② REFERENCE C

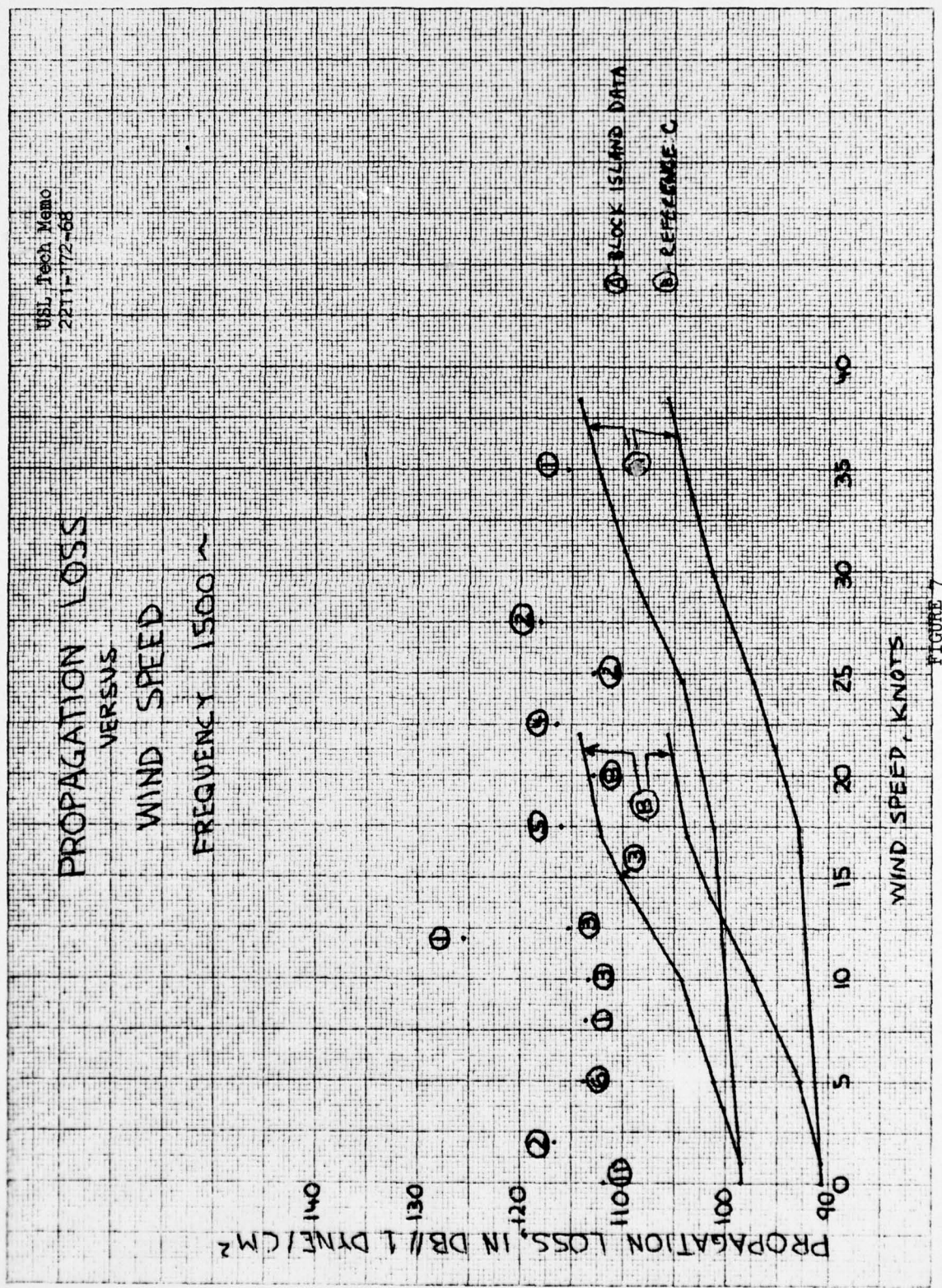


FIGURE 7



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# PROPAGATION LOSS

VERSUS

WIND SPEED

FREQUENCY 1900~

PROPAGATION LOSS IN DB//1 DYNE/CM<sup>2</sup>

40

35

30

25

20

15

10

5

0

WIND SPEED, KNOTS

FIGURE 8

(A) BLOCK ISLAND DATA

(B) REFERENCE C



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## EXTREMES OF PROPAGATION LOSS



FIGURE 9



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# AMBIENT NOISE LEVELS

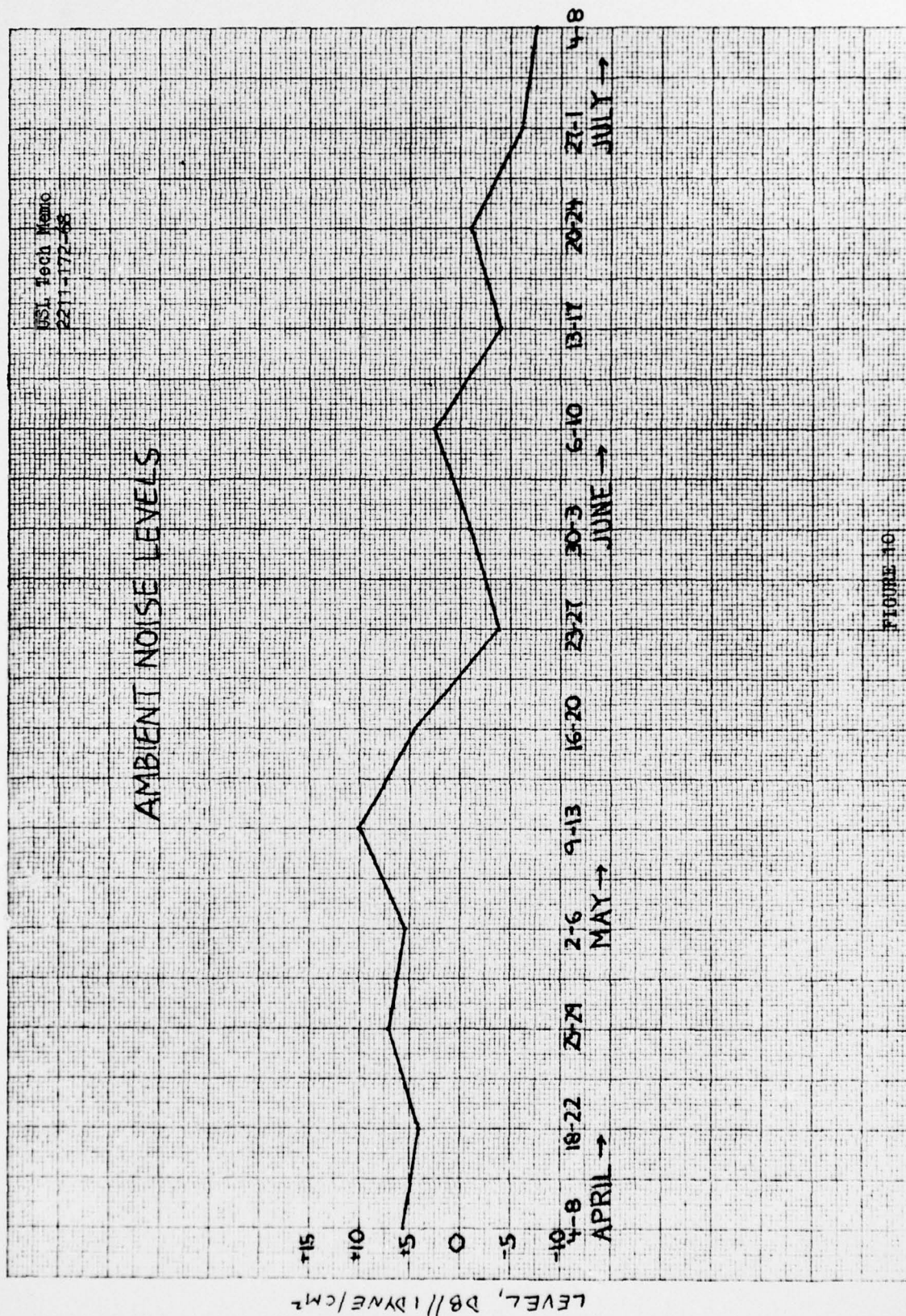


FIGURE 10